

## PATENT COOPERATION TREATY

PCT/US2004/00036

Rec'd PCT/PT 27 JUN 2005  
PCT

From the INTERNATIONAL BUREAU

NOTIFICATION CONCERNING  
TRANSMITTAL OF COPY OF INTERNATIONAL  
APPLICATION AS PUBLISHED OR REPUBLISHED

To:

WHITHAM, Michael, E.  
Whitham, Curtis & Christofferson, P.C.  
11491 Sunset Hills Road  
Suite 340  
Reston, VA 20190  
ETATS-UNIS D'AMERIQUEDate of mailing (day/month/year)  
29 July 2004 (29.07.2004)Applicant's or agent's file reference  
01640393TA

## IMPORTANT NOTICE

International application No.  
PCT/US2004/000363International filing date (day/month/year)  
09 January 2004 (09.01.2004)Priority date (day/month/year)  
09 January 2003 (09.01.2003)

Applicant

VIRGINIA TECH INTELLECTUAL PROPERTIES, INC. et al

The International Bureau transmits herewith the following documents:

- ☒ copy of the international application as published by the International Bureau on 29 July 2004 (29.07.2004) under No. WO 2004/062351
- ☐ copy of international application as republished by the International Bureau on under No. WO
- For an explanation as to the reason for this republication of the international application, reference is made to INID codes (15), (48) or (88) (as the case may be) on the front page of the attached document.

The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

Authorized officer

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27 JUN 2005

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
29 July 2004 (29.07.2004)

PCT

(10) International Publication Number  
WO 2004/062351 A2

- (51) International Patent Classification<sup>7</sup>: A01H
- (21) International Application Number:  
PCT/US2004/000363
- (22) International Filing Date: 9 January 2004 (09.01.2004)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
60/438,801 9 January 2003 (09.01.2003) US
- (71) Applicant (for all designated States except US): VIRGINIA TECH INTELLECTUAL PROPERTIES, INC.  
[US/US]; 1872 Pratt Drive, Suite 1625, Blacksburg, VA 24060 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): WHALEY, Cory,
- (74) Agents: WHITHAM, Michael, E. et al.; Whitham, Curtis & Christofferson, P.C., 11491 Sunset Hills Road, Suite 340, Reston, VA 20190 (US).
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH,

[Continued on next page]

(54) Title: GENE ENCODING RESISTANCE TO ACETOLACTATE SYNTHASE-INHIBITING HERBICIDES

R11-AMACH SSSSQSPKPKPPSATITQSPSSLTDDKPSFVSFRSPPEEPRKGCVDLVEA 101  
S-AMACH SSSSQSPKPKPPSATITQSPSSLTDDKPSFVSFRSPPEEPRKGCVDLVEA 101

R11-AMACH LEREGVTDVFAYPGGASMEIHQALTRSNIIRNVLPREHQQGVFAAEGYAR 151  
S-AMACH LEREGVTDVFAYPGGASMEIHQALTRSNIIRNVLPREHQQGVFAAEGYAR 151

R11-AMACH ATGRVGVCIATSGPGATNLVSLGLADALLDSVPLVAITGQVPRRMIGTDAF 201  
S-AMACH ATGRVGVCIATSGPGATNLVSLGLADALLDSVPLVAITGQVPRRMIGTDAF 201

R11-AMACH QETPIVEVTRSIKHNLYLVLDVEDIPRIKVEAFFLANSGRGPVLIDIPK 251  
S-AMACH QETPIVEVTRSIKHNLYLVLDVEDIPRIKVEAFFLANSGRGPVLIDIPK 251

R11-AMACH DIQQQLVVPNWEQPIKLGGLYLSRLPKPTYSANEEGLLDQIVRLVGESKRP 301  
S-AMACH DIQQQLVVPNWEQPIKLGGLYLSRLPKPTYSANEEGLLDQIVRLVGESKRP 301

R11-AMACH VLYTGGGCLNSSEELRKFVELTGIPVASTLMGLGAFFCTDDLSLHMLGMH 351  
S-AMACH VLYTGGGCLNSSEELRKFVELTGIPVASTLMGLGAFFCTDDLSLHMLGMH 351

R11-AMACH GTVYANYAVDKADLLAFGVRFDERVTGKLEAFASRAKIVHIDIDSAEIG 401  
S-AMACH GTVYANYAVDKADLLAFGVRFDERVTGKLEAFASRAKIVHIDIDSAEIG 401

R11-AMACH KKNQPHVSICGDVKVALQGLNKILESRRKGVKLDFSNWREELNEQKKKFP 451  
S-AMACH KKNQPHVSICGDVKVALQGLNKILESRRKGVKLDFSNWREELNEQKKKFP 451

R11-AMACH LSFKTFGDAIPPQYAIQVLDLTKGDAVVSTGVGQHQMMAAQFYKYRNPR 501  
S-AMACH LSFKTFGDAIPPQYAIQVLDLTKGDAVVSTGVGQHQMMAAQFYKYRNPR 501

R11-AMACH QWLTSGGLGAMGFLPAAIGA AAVRPDAVVVDIDGGSFIMNVQELATIR 551  
S-AMACH QWLTSGGLGAMGFLPAAIGA AAVRPDAVVVDIDGGSFIMNVQELATIR 551

R11-AMACH VENLPVKIMLLNNQHLGMVVQWEDRFYKANRAHTYLGNPNSSEIFPDML 601  
S-AMACH VENLPVKIMLLNNQHLGMVVQWEDRFYKANRAHTYLGNPNSSEIFPDML 601

R11-AMACH KFAEACDIPAARVTKVSDLRRAAIQTMLDTPGPYLLDVIVPHQEHVLPMP 651  
S-AMACH KFAEACDIPAARVTKVSDLRRAAIQTMLDTPGPYLLDVIVPHQEHVLPMP 651

R11-AMACH SGAAFKDTITEGDGRRAY 669  
S-AMACH SGAAFKDTITEGDGRRAY 669

(57) Abstract: A mutant acetolactate synthase (ALS) enzyme that confers cross-resistance to all sulfonylurea, imidazolinone, pyrimidinyloxybenzoate, triazolopyrimidine and sulfonylamino-carbonyl-triazolinone herbicides is provided. The mutant enzyme contains an aspartic acid to glutamic acid substitution mutation at a newly identified conserved region of the ALS enzyme. A gene encoding the enzyme is also provided, as are transgenic plants that have been genetically engineered to contain and express the gene. The transgenic plants are cross-resistant to sulfonylurea, imidazolinone, pyrimidinyloxybenzoate, triazolopyrimidine and sulfonylamino-carbonyl-triazolinone herbicides.

WO 2004/062351 A2



GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**

— *without international search report and to be republished upon receipt of that report*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property  
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(43) International Publication Date  
29 July 2004 (29.07.2004)

PCT

(10) International Publication Number  
WO 2004/062351 A3

- (51) International Patent Classification<sup>7</sup>: C12N 9/10, 15/29, 52/82
- (21) International Application Number: PCT/US2004/000363
- (22) International Filing Date: 9 January 2004 (09.01.2004)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: 60/438,801 9 January 2003 (09.01.2003) US
- (71) Applicant (for all designated States except US): VIRGINIA TECH INTELLECTUAL PROPERTIES, INC. [US/US]; 1872 Pratt Drive, Suite 1625, Blacksburg, VA 24060 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): WHALEY, Cory, M. [US/US]; 26558 Kaye Road, Seaford, DE 19973 (US). WILSON, Henry, P. [US/US]; P.O.Box 116, Belle Haven, VA 23306 (US). WESTWOOD, James, H. [US/US]; 3715 Millstone Ridge Road, Blacksburg, VA 24060 (US).
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- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- Published:  
— with international search report  
— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments
- (88) Date of publication of the international search report: 12 May 2005
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: GENE ENCODING RESISTANCE TO ACETOLACTATE SYNTHASE-INHIBITING HERBICIDES

(57) Abstract: A mutant acetolactate synthase (ALS) enzyme that confers cross-resistance to all sulfonylurea, imidazolinone, pyrimidinyloxybenzoate, triazolopyrimidine and sulfonylamino-carbonyl-triazolinone herbicides is provided. The mutant enzyme contains an aspartic acid to glutamic acid substitution mutation at a newly identified conserved region of the ALS enzyme. A gene encoding the enzyme is also provided, as are transgenic plants that have been genetically engineered to contain and express the gene. The transgenic plants are cross-resistant to sulfonylurea, imidazolinone, pyrimidinyloxybenzoate, triazolopyrimidine and sulfonylamino-carbonyl-triazolinone herbicides.

WO 2004/062351 A3

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US04/00363

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC(7) : C12N 9/10, 15/29, 52, 82 US CL : 435/193;536/23.2;800/278,300 According to International Patent Classification (IPC) or to both national classification and IPC																						
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) U.S. : 435/193;536/23.2;800/278,300 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EAST(USPAT,EPO,JPO,DERWENT), STN(Agricola, Biosis, Caplus, Embase), Sequence search of SEQ ID NO: 1 & 2																						
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b> <table border="1"> <thead> <tr> <th>Category *</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>US 5,633,437 (BERNASCONI et al) 27 May 1997 (27.05.1997), entire document, especially Fig. 2, columns 7 and 8, claims 1,2,10,14 and 16.</td> <td>1-12</td> </tr> </tbody> </table>			Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	US 5,633,437 (BERNASCONI et al) 27 May 1997 (27.05.1997), entire document, especially Fig. 2, columns 7 and 8, claims 1,2,10,14 and 16.	1-12														
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<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.																						
<table border="1"> <thead> <tr> <th colspan="2">Special categories of cited documents:</th> </tr> </thead> <tbody> <tr> <td>"A"</td> <td>document defining the general state of the art which is not considered to be of particular relevance</td> </tr> <tr> <td>"E"</td> <td>earlier application or patent published on or after the international filing date</td> </tr> <tr> <td>"L"</td> <td>document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> </tr> <tr> <td>"O"</td> <td>document referring to an oral disclosure, use, exhibition or other means</td> </tr> <tr> <td>"P"</td> <td>document published prior to the international filing date but later than the priority date claimed</td> </tr> <tr> <td>"T"</td> <td>later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>"X"</td> <td>document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> </tr> <tr> <td>"Y"</td> <td>document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> </tr> <tr> <td>"&amp;"</td> <td>document member of the same patent family</td> </tr> </tbody> </table>			Special categories of cited documents:		"A"	document defining the general state of the art which is not considered to be of particular relevance	"E"	earlier application or patent published on or after the international filing date	"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"O"	document referring to an oral disclosure, use, exhibition or other means	"P"	document published prior to the international filing date but later than the priority date claimed	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	"&"	document member of the same patent family
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"&"	document member of the same patent family																					
Date of the actual completion of the international search 04 March 2005 (04.03.2005)		Date of mailing of the international search report 18 MAR 2005																				
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (703) 305-3230		Authorized officer: <i>Maria Pablos</i> David H Kruse Telephone No. (571) 272-0547																				

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US04/00363

## BOX III. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING

Group I, claim(s) 1-3, drawn to a substantially purified acetolactate synthase enzyme.

Group II, claim(s) 4-6, drawn to a substantially purified ALS gene encoding an ALS enzyme with cross-resistance to multiple herbicides.

Group III, claim(s) 7-13, drawn to a method of conferring cross-resistance to multiple herbicides into a plant comprising introducing a gene encoding an ALS enzyme with cross-resistance to multiple herbicides and a transgenic plant produced therefrom.

The inventions listed as Groups I-III do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: The ALS enzyme with cross-resistance to multiple herbicides of claim 1 and Group I was known in the art at the time of Applicant's invention and thus the claims lack the same corresponding special technical feature under PCT Rule 13.2.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US04/00363

**Box No. I**      **Nucleotide and/or amino acid sequence(s) (Continuation of item 1.b of the first sheet)**

1. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, the international search was carried out on the basis of:

a. type of material



a sequence listing



table(s) related to the sequence listing

b. format of material



in written format



in computer readable form

c. time of filing/furnishing



contained in the international application as filed



filed together with the international application in computer readable form



furnished subsequently to this Authority for the purposes of search

2. ☒ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

3. Additional comments:

# INTERNATIONAL SEARCH REPORT

International Application No.

PCT/US04/00363

## Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:  
Please See Continuation Sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
  2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
- Remark on Protest ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.



# TENT COOPERATION TREATY

Rec'd PCT/PTO

27 JUN 2005



From the INTERNATIONAL SEARCHING AUTHORITY

To:

MICHAEL E. WHITHAM

WHITHAM, CURTIS & CHRISTOFFERSON, P.C.

11491 SUNSET HILLS ROAD, SUITE 340

RESTON, VA 20190

**PCT**

NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL SEARCH REPORT AND  
THE WRITTEN OPINION OF THE INTERNATIONAL  
SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

RECEIVED  
MAR 21 2005  
WHITHAM, CURTIS &  
CHRISTOFFERSON, P.C.

Date of mailing  
(day/month/year)

18 MAR 2005

Applicant's or agent's file reference  
01640393TA

**FOR FURTHER ACTION** See paragraphs 1 and 4 below

International application No.  
PCT/US04/00363

International filing date  
(day/month/year) 09 January 2004 (09.01.2004)

Applicant  
VIRGINIA TECH INTELLECTUAL PROPERTIES, INC.

1. ☐ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

**Filing of amendments and statement under Article 19:**

The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

**When?** The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

**Where?** Directly to the International Bureau of WIPO, 34 chemin des Colombettes  
1211 Geneva 20, Switzerland, Facsimile No.: +41 22 740 14 35

For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ With regard to the protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

Shortly after the expiration of 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established. These comments would also be made available to the public but not before the expiration of 30 months from the priority date.

Within 19 months from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later); otherwise, the applicant must, within 20 months from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices.

In respect of other designated Offices, the time limit of 30 months (or later) will apply even if no demand is filed within 19 months.

See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicant's Guide*, Volume II, National Chapters and the WIPO Internet site.

Name and mailing address of the ISA/ US  
Mail Stop PCT, Attn: ISA/US  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
Facsimile No. (703) 305-3230

Authorized officer

David H Kruse

Telephone No. (571) 272-0547

# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 01640393TA	<b>FOR FURTHER ACTION</b> <small>see Form PCT/ISA/220 as well as, where applicable, item 5 below.</small>	
International application No. PCT/US04/00363	International filing date (day/month/year) 09 January 2004 (09.01.2004)	(Earliest) Priority Date (day/month/year) 01 September 2003 (01.09.2003)
Applicant VIRGINIA TECH INTELLECTUAL PROPERTIES, INC.		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 5 sheets.



It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the Report**

a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.



The international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).



b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, see Box No. I.

2. ☐ Certain claims were found unsearchable (See Box No. II)

3. ☒ Unity of invention is lacking (See Box No. III)

4. With regard to the title,



the text is approved as submitted by the applicant.



the text has been established by this Authority to read as follows:

5. With regard to the abstract,



the text is approved as submitted by the applicant.



the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the drawings,

a. the figure of the drawings to be published with the abstract is Figure No. \_\_\_\_



as suggested by the applicant.



as selected by this Authority, because the applicant failed to suggest a figure.



as selected by this Authority, because this figure better characterizes the invention.



b. none of the figures is to be published with the abstract.

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US04/00363

## Box No. I Nucleotide and/or amino acid sequence(s) (Continuation of item 1.b of the first sheet)

1. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, the international search was carried out on the basis of:

a. type of material



a sequence listing



table(s) related to the sequence listing

b. format of material



in written format



in computer readable form

c. time of filing/furnishing



contained in the international application as filed



filed together with the international application in computer readable form



furnished subsequently to this Authority for the purposes of search

2. ☒ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

3. Additional comments:

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US04/00363

## Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:  
Please See Continuation Sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐  
☐

The additional search fees were accompanied by the applicant's protest.

No protest accompanied the payment of additional search fees.

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US04/00363

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : C12N 9/10, 15/29, 52, 82

US CL : 435/193; 536/23.2; 800/278, 300

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 435/193; 536/23.2; 800/278, 300

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
EAST(USPAT, EPO, JPO, DERWENT), STN(Agricola, Biosis, Caplus, Embase), Sequence search of SEQ ID NO: 1 & 2

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,633,437 (BERNASCONI et al) 27 May 1997 (27.05.1997), entire document, especially Fig. 2, columns 7 and 8, claims 1, 2, 10, 14 and 16.	1-12



Further documents are listed in the continuation of Box C.



See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T"

later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X"

document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"

document member of the same patent family

Date of the actual completion of the international search

04 March 2005 (04.03.2005)

Date of mailing of the international search report

18 MAR 2005

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US

Commissioner for Patents

P.O. Box 1450

Alexandria, Virginia 22313-1450

Facsimile No. (703) 305-3230

Authorized officer

David H Kruse

Telephone No. (571) 272-0547

**BOX III. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING**

Group I, claim(s) 1-3, drawn to a substantially purified acetolactate synthase enzyme.

Group II, claim(s) 4-6, drawn to a substantially purified ALS gene encoding an ALS enzyme with cross-resistance to multiple herbicides.

Group III, claim(s) 7-13, drawn to a method of conferring cross-resistance to multiple herbicides into a plant comprising introducing a gene encoding an ALS enzyme with cross-resistance to multiple herbicides and a transgenic plant produced therefrom.

The inventions listed as Groups I-III do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: The ALS enzyme with cross-resistance to multiple herbicides of claim 1 and Group I was known in the art at the time of Applicant's invention and thus the claims lack the same corresponding special technical feature under PCT Rule 13.2.

# PATENT COOPERATION TREATY

From the  
INTERNATIONAL SEARCHING AUTHORITY

## PCT

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

To:  
MICHAEL E. WHITHAM  
WHITHAM, CURTIS & CHRISTOFFERSON, PC  
11491 SUNSET HILLS ROAD, SUITE 340  
RESTON, VA 20190

Date of mailing  
(day/month/year) **18 MAR 2005**

Applicant's or agent's file reference

**FOR FURTHER ACTION**

See paragraph 2 below

01640393TA

International application No.

International filing date (day/month/year)

Priority date (day/month/year)

PCT/US04/00363

09 January 2004 (09.01.2004)

01 September 2003 (01.09.2003)

International Patent Classification (IPC) or both national classification and IPC

IPC(7): C12N 9/10, 15/29, 52, 82 and US Cl.: 435/193, 536/23.2; 800/278, 300

Applicant

VIRGINIA TECH INTELLECTUAL PROPERTIES, INC.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☒ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

### 2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/ US

Mail Stop PCT, Attn: ISA/US  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, Virginia 22313-1450

Facsimile No. (703) 305-3230

Authorized officer

David H Kruse

Telephone No. (571) 272-0547

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US04/00363

Box No. I Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.  
☐ This opinion has been established on the basis of a translation from the original language into the following language \_\_\_\_\_, which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
  - a. type of material  
☒ a sequence listing  
☒ table(s) related to the sequence listing
  - b. format of material  
☒ in written format  
☒ in computer readable form
  - c. time of filing/furnishing  
☐ contained in international application as filed.  
☐ filed together with the international application in computer readable form.  
☒ furnished subsequently to this Authority for the purposes of search.
3. ☒ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:



**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US04/00363

**Box No. IV Lack of unity of invention**

1. ☐ In response to the invitation (Form PCT/ISA/206) to pay additional fees the applicant has:
- ☐ paid additional fees
- ☐ paid additional fees under protest
- ☐ not paid additional fees
2. ☒ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is
- ☐ complied with
- ☒ not complied with for the following reasons:
- See the lack of unity section of the International Search Report (Form PCT/ISA/210)

4. Consequently, this opinion has been established in respect of the following parts of the international application:

- ☒ all parts.
- ☐ the parts relating to claims Nos. \_\_\_\_\_

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

International application No.  
PCT/US04/00363

**Box No. V Reasoned statement under Rule 43 bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Claims <u>13</u>	YES
	Claims <u>1-12</u>	NO
Inventive step (IS)	Claims <u>13</u>	YES
	Claims <u>1-12</u>	NO
Industrial applicability (IA)	Claims <u>1-13</u>	YES
	Claims <u>NONE</u>	NO

**2. Citations and explanations:**

Claims 1-12 lack novelty under PCT Article 33(2) as being anticipated by Bernasconi *et al* (U.S. Patent 5,633,437). The prior art discloses an isolated acetolactate synthase enzyme with cross-resistance to multiple herbicides (see the Abstract and column 7). The prior art discloses an isolated ALS gene encoding an ALS enzyme that confers in a plant cross-resistance to multiple herbicides, a method of making a transgenic plant with said ALS gene and a transgenic plant produced by said method having cross-resistance to multiple herbicides (see claims 1,2,10,14 and 16). The recitation of "or a fragment thereof" as directed to SEQ ID NO: 2 or SEQ ID NO: 1 does not distinguish the claimed gene from that disclosed in the prior art.

Claim 13 meets the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest an ALS enzyme with an aspartic acid to glutamic acid substitution at position six of a conserved sequence GVRFDDRVTGK.

Claims 1-13 meet the criteria set out in PCT Article 33(4), and thus meet industrial applicability because the subject matter claimed can be made or used in industry.

**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US04/00363

**Box No. VIII    Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the questions whether the claims are fully supported by the description, are made:

Claims 1-12 are objected to as lacking clarity under PCT Rule 66.2(a)(v) because the claims are not fully supported by the description. The application, as originally filed, did not describe: The nucleic acid sequence of SEQ ID NO: 1 and the amino acid sequence of SEQ ID NO: 2 do not appear to describe a complete ALS gene or enzyme, respectively.

## NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under Article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the *PCT Applicant's Guide*, a publication of WIPO.

In these Notes, "Article," "Rule" and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions, respectively.

### INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

#### What parts of the international application may be amended?

Under Article 19, only the claims may be amended

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Preliminary Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

**When?** Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

#### Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

**How?** Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

#### What documents must/may accompany the amendments?

##### Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.